

# ELYTRAL VESTITURE AND ITS BIOSYSTEMATIC SIGNIFICANCE IN ENTIMINAE (CURCULIONIDAE: COLEOPTERA)<sup>1</sup>

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(With two plates and thirty-seven text-figures)

**Key words:** Elytral vestiture, biosystematics, Curculionidae, Entiminae, SEM investigations

Studies on the entimine weevil genera, namely *Myllocerus* Schoenherr of Otiorrhynchini, *Tanymecus* Germar, *Burmanicus* Supare, *Krauseus* Supare and *Lepropus* Schoenherr of Brachyderini, demonstrated that the elytral vestiture consists predominantly of flat scales, which overlap each other on the intervals of elytra, while the less predominant erect/sub-erect ones are elongate, found lining the striae or in the middle of intervals. There is enormous morphological diversity in the elytral vestiture and yet there is consistency at different hierarchical levels denoting its diagnostic value. It is concluded that elytral vestiture can help a taxonomist to take confident taxonomic decisions on the species diagnosis, revisions at generic and other levels, and monophyletic nature of taxa. Scanning electron microscope investigations have corroborated this conclusion. Incidentally, it has been shown that gold coating impairs the results as it defaces the finer structures.

## INTRODUCTION

The Curculionidae are one of the largest group of weevils which, with their destructive potential, are capable of inflicting great economic damage to man. Entiminae is one such subfamily, containing many economically important genera. Many of these are large, complex, and perplexing to taxonomists; thus there is a need to identify additional taxonomic characters of diagnostic value. In 1916, while concluding his notes on the Indian Curculionidae, Marshall emphasized this and spelt out the importance of superficial hairs and scales, as these exhibit structural and morphological diversity. He also mentioned that comparatively little attention has been paid by systematists to the structure of scales, though these often exhibit good specific and even generic characters. Some attempts were made to study this character on the elytra referred to as "elytral vestiture" (Ramamurthy and Ghai 1988, Supare

*et al.* 1990, Ramamurthy *et al.* 1992, and Poorani and Ramamurthy 1997). The present study is an attempt to integrate these findings, corroborate the same with Scanning Electron Microscope (SEM) investigations, and evaluate its utility in diagnostics.

## MATERIAL AND METHODS

The specimens selected for the study were examined under magnifications ranging from 6x to 160x. The elytral vestiture was studied *in situ* to know the type and arrangement, and to select characters for detailed examination. The Wild M8 Stereo Zoom Microscope was used for this. To study the details of the scales, the elytra was scratched with a minuten pin on to a cavity slide containing a drop of ethyl alcohol (mixed with glycerol to avoid instant drying). Gentle stirring with the minuten helped separate the scales. These were then covered with a cover-slip and examined under Leitz Ortholux II Interference Phase Contrast Microscope at magnifications from 200x to 400x. The illustrations were made using a drawing tube fitted with a mirror camera

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lucida. The microphotographs were made with a Wild MPS 45 microphotoautomat. SEM studies were done in a Carl Zeiss Digital Scanning Microscope, model DSM 962, capable of high resolution image storage, real time image processing and image recording on digital media, integrated with arrangements for critical point drying and gold coating. The key parameters namely magnification, micron marker bar, accelerating voltage and working distance are indicated in the data field in the pictures.

### RESULTS

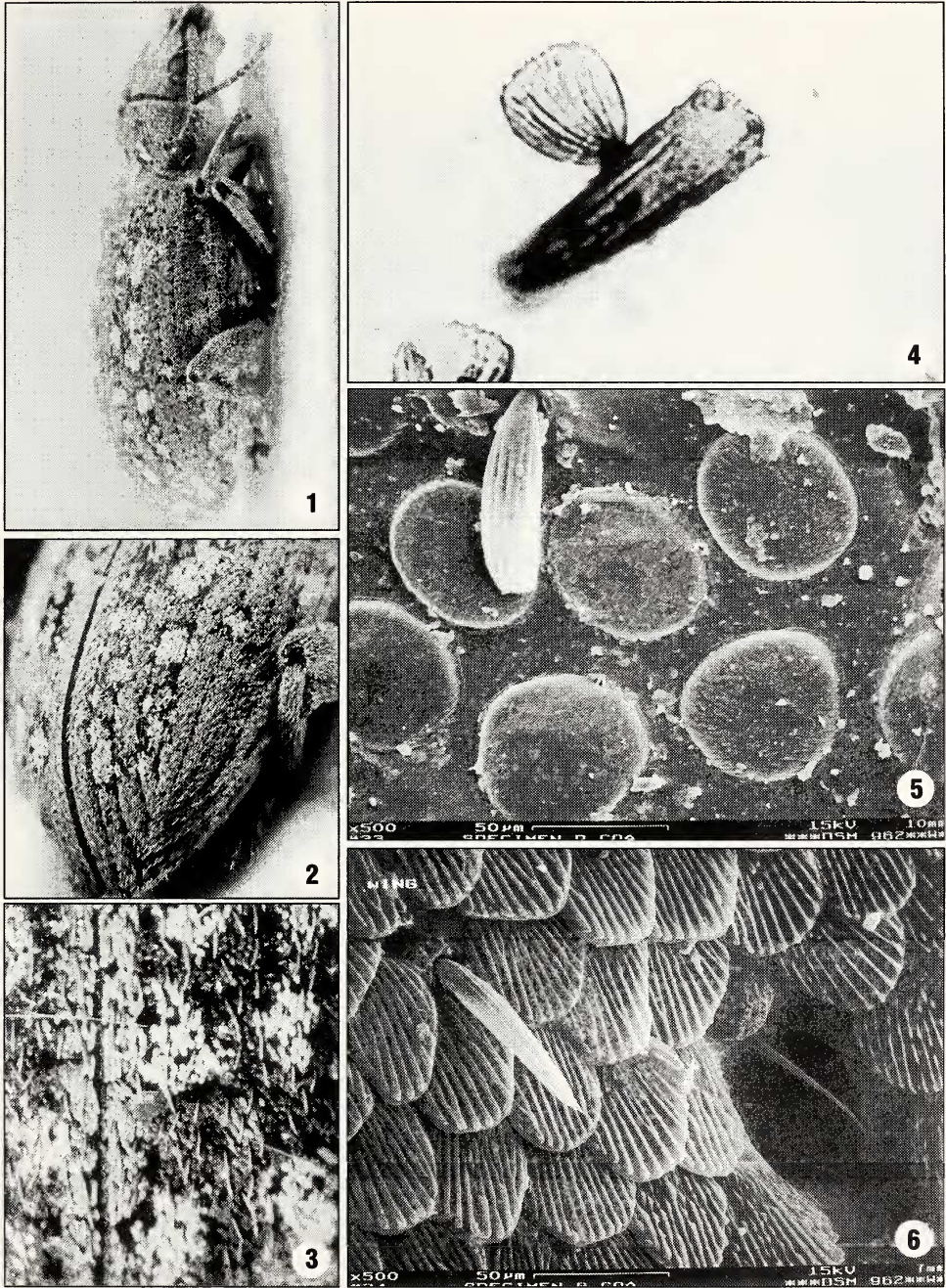
The preliminary examination of the superficial clothing in Curculionidae showed that the elytral vestiture is striking, consistent and diagnostically significant. At magnifications from 6x to 50x, this vestiture was seen in the form of scales, setae, hairs and fine pubescence, of which the scales are most apparent, as they cover the whole elytra, making it squamose and with various colour patterns (eg. *Myllocerus discolor* Fabricius, Plate 1, Figs 1, 2). In the subfamily Entiminae, the intervals of the elytra are almost always carpeted by these overlapping scales, which are always predominant, and supplemented with more or less regular rows of the less predominant elongate, erect or sub-erect scales. These frequently furnish excellent generic and/or specific characters (Plate 1, Fig. 3).

The predominant scales overlap each other, entirely cover the intervals and extend to the brim of the punctuation of striae. These scales are always very flat, ovate or circular, rarely elongate oval, with or without pedicel, ridges or grooves, densely or sparsely clothed with short or long, thin or thick, straight or wavy hairs; in some the ridges extend beyond the apical margin too (Plate 1, Fig 4; Figs 11, 13; 15, 17, 18, 20, 25, 27, 29, 30, 32, 34, 35, 38, 39, 41, 43, 46). The less predominant are short or long, erect or sub-erect, recumbent or sub-recumbent, based on the angle

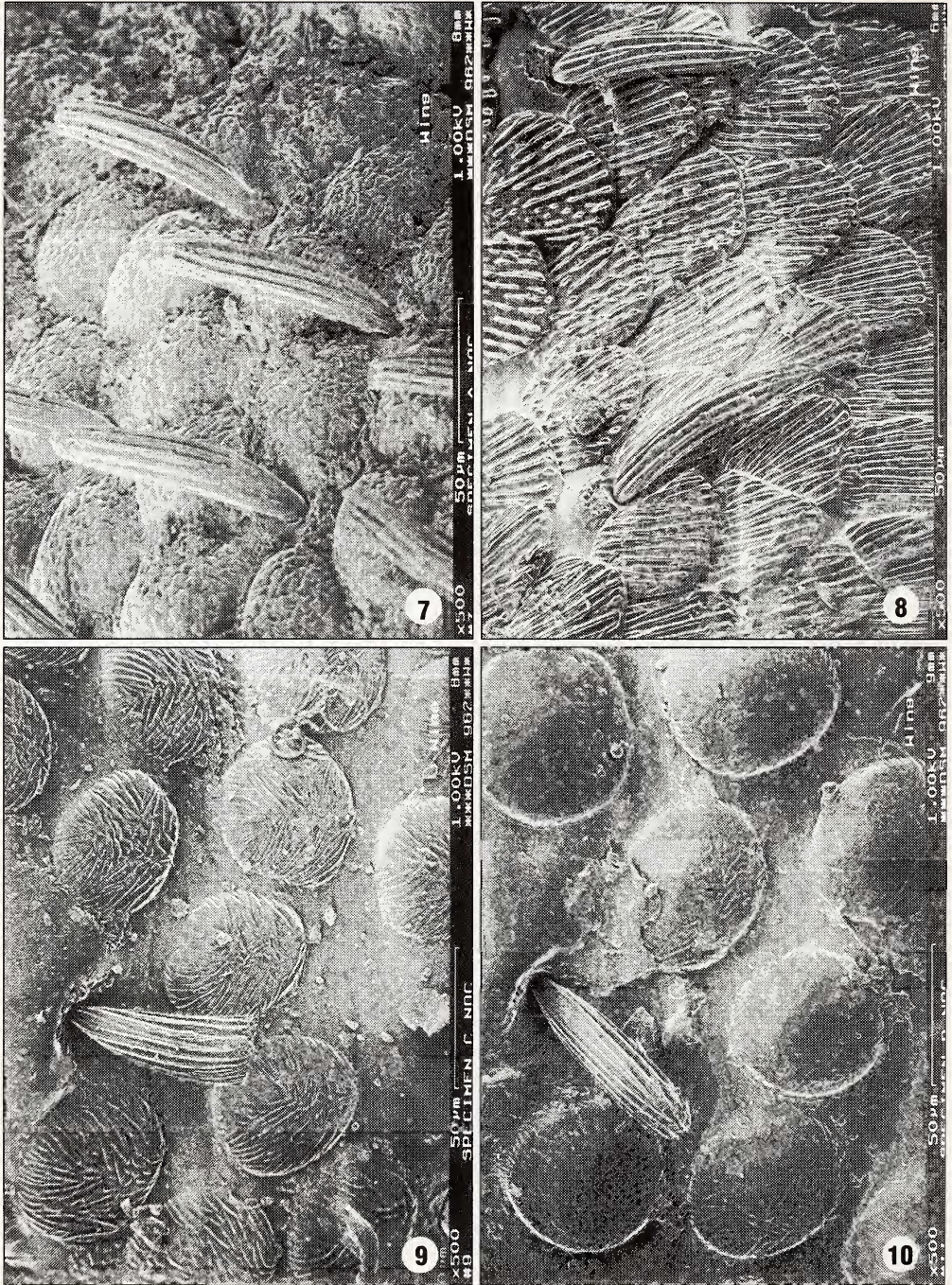
with which they are attached to the surface of elytra. But they are always elongate, and mostly found on either margins of intervals lining the striae or in rows in the middle of intervals (Plate 1, Fig 4; Figs 12, 14, 16, 19, 21-24, 26, 28, 31, 33, 36, 37, 40, 42, 44, 45, 47). Marshall (1916) used the term setae for them, but they are also scales in the true sense. The morphological diversity of these scales varies between species, genera and tribes, as explained below.

In *Myllocerus pallipes* (Roelofs), the scales on the intervals are broadly ovate, disc-like, extremely convex, with margins inverted, pedicel distinct, ridges 6-8 (Fig. 11). The scales on the strial margins are elongate, short, conical, pedicel broad and distinct, grooves 3-4 (Fig. 12). All these agree with other species of *Myllocerus* Schoenherr. *M. procerus* Faust is characterized by the presence of discal spots, ovate or round shape, straight apical margin, with pedicel, ridges 8-10 (Figs 17, 18). The scales on the strial margins are elongate, spindle-shaped, with their apices curved (Fig. 26). Closely related species, namely *M. dentifer* Fabricius and *M. discolor* (Boheman) have an elytral vestiture as detailed below: in *dentifer*, scales on the intervals circular, with pedicel, apex straight, ridges 7-8 (Fig. 13), scales on the strial margins conical, grooves 4-6 (Fig. 14), while *discolor* has ovate scales with pedicel, apex narrowed and pointed, ridges 8-9 (Fig. 15), of which those on the strial margins are elongate, conical, curved, with 2-3 grooves (Fig. 16).

In *Tanymecus* Germar, species differ in having their flat scales clothed with thick, thin, long or short hairs and with or without pedicel (Figs 20-25, 27-29). *T. mandibularis* Marshall (Fig. 29), *hirticeps* Marshall (Fig. 25), *chloroleucus* (Wiedemann) (Fig. 27) and *circumdatus* (Wiedemann) (Fig. 20), all have their flat scales on the intervals ovate, with distinct, rounded pedicel, clothed with a few thick, short hairs (Fig. 29), thick, long hairs (Figs 25, 27) or dense, thin, short hairs (Fig. 20). In

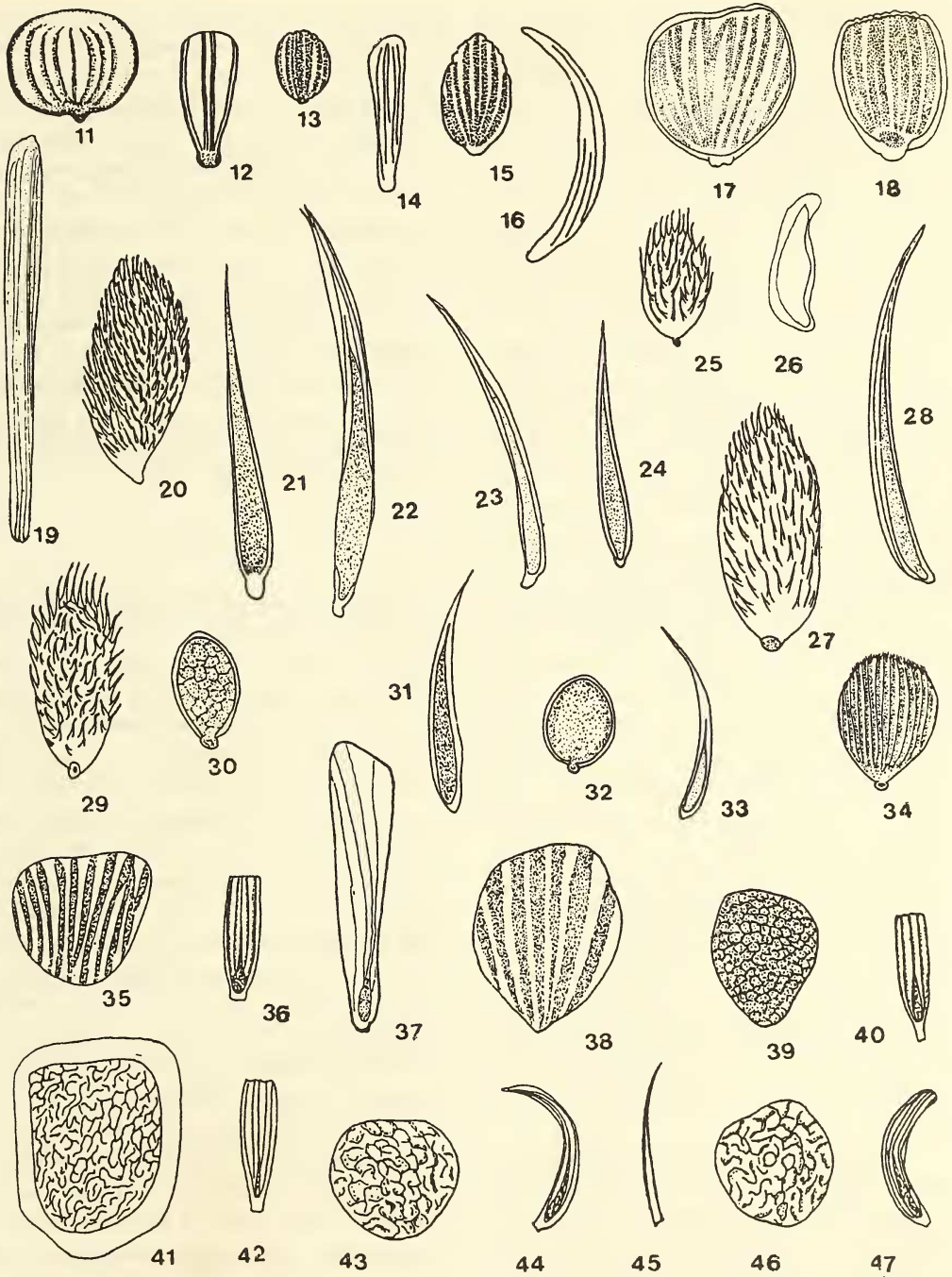


Figs 1-6: Elytral vestiture of Entiminae (for details see text)



Figs 7-10: Elytral vestiture of Entiminae (for details see text)

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Figs 11-47: Elytral vestiture of Entiminae (for details see text)

these, the scales lining the strial margins are conical, curved or straight, with an indistinct or distinct pedicel (Figs. 21-24, 28). *Burmanicus* Supare and *Krauseus* Supare have similar scales, except for the absence of hairs on flat scales, ovate or round, characteristic with peripheries distinctly demarcated, median area raised, surface reticulately smooth, with a distinct, rounded pedicel (Fig. 30, 32), their scales lining the strial margins/ middle of intervals conical, without a distinct pedicel (Figs 31, 33). In *Krauseus*, these scales are broadly ovate, rather disc-like, with base slightly narrowed with a distinct rounded pedicel, apex fringed with very thin, delicate hairs, median area with 13-15 ridges, some of these projecting slightly beyond apical margin (Fig. 34), other scales conical, but truncate at apex, base with a very small, indistinct pedicel, with 6-8 grooves (Fig. 19).

In *Lepropus* Schoenherr, the species *oculatus* (Heller) and *gestroi* (Marshall) have their flat scales subrectangular to subovate (Fig. 35), or ovate, narrowed at the base with a short, rounded pedicel, with 7-10 ridges (Fig. 38), while the elongate ones are curved, with or without pedicel, with 3-5 ridges (Fig. 36) or without any ridges (Fig. 37). In *Brachyaspistes* Schoenherr, these flat scales are ovate, subovate, subcircular with irregular impressions (Figs 43, 46), longer than broad, somewhat angular, with a raised boss in the middle, with irregular criss-cross impressions (Fig. 41), their scales on the strial margins elongate, gradually broadened towards apex, with 4-5 ridges and a pedicel (Figs 40, 42), curved, with a short pedicel, with 3-5 ridges (Figs 44, 47) or hairs or setae (Fig. 45).

SEM investigations on *Brachyaspistes femoralis* Fahraeus indicate that the flat scales are subcircular, their median area raised, and with irregular impressions (Plate 2, Fig. 7) and those on the strial margins characterized by 3-5 ridges. Likewise, *Lepropus chrysochlorus* (Wiedemann) has its scales ovate, with 8-15

ridges (Plate 1, Fig 6; Plate 2, Fig. 8), of which the ridges are clear in non-coated specimens (Plate 2, Fig. 8), while in coated specimens they get smothered, concealing the breaks in the ridges (Plate 1, Fig. 6). The basic green morph of *L. lateralis* (Fabricius) has their predominant scales subcircular with irregular, very fine ridges, less predominant ones curved, elongate, broader at apex than at base, with a pedicel, with 4-5 ridges (Plate 2, Fig. 9). The grey morph of *L. lateralis* showed similar scales except for the ridges becoming much finer (Plate 2, Fig. 10). When coated with gold for SEM, these fine ridges tend to get camouflaged, indicating that a gold coating may give misleading results in case of fine differences (Plate 1, Fig. 5).

#### DISCUSSION

It can be concluded that entimine genera of different tribes have variations in elytral vestiture which confirm their placement at different suprageneric levels. In a complex genus like *Mylolocerus*, it has been established that by utilizing this single character we can identify some species such as *procerus*. Elytral vestiture could be used to distinguish very closely related borderline species like *dentifer* and *discolor*, which are otherwise inseparable with customary taxonomic characters. It has been demonstrated that this character can aid revisions at generic level, like the synonymy of *Hyperstylus* Roelofs with *Mylolocerus* (Ramamurthy *et al.* 1992), distinction of *Tanymecus*, *Krauseus* and *Burmanicus* (Supare *et al.* 1990), *Tanymecus* vs. *Esamus* Chevrolat (Ramamurthy and Ghai 1991), and *Lepropus* vs. *Brachyaspistes* (Ramamurthy *et al.* 1998). SEM studies have corroborated the authenticity of these taxonomic decisions. Incidentally, it was established that given certain conditions, there is no need to gold-coat the specimens, which defaces the finer features of the elytral vestiture. The present study confirms the findings of Lacordaire (1863) and

others, that the elytral vestiture can be renewed by the insect after they have been rubbed off, form a regular pattern, these are powdery secretions, their structure is specific, and is of great biosystematic significance, especially in Subfamily Entiminae of Curculionidae.

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REFERENCES

- LACORDAIRE, T. (1863): Histoire naturelle des Insectes. Genera des Coleopteres, 6. Roret, Paris. (iv) + 637 pp.
- POORANI, J. & V.V. RAMAMURTHY (1997): Weevils of the genus *Lepropus* Schoenherr from the Oriental region (Coleoptera: Curculionidae: Entiminae). *Oriental Ins.* 31: 1-82.
- RAMAMURTHY, V.V. & S. GHAI (1988): A study on the genus *Myloccerus* (Coleoptera: Curculionidae). *Oriental Ins.* 22: 377-500.
- RAMAMURTHY, V.V. & S. GHAI (1991): On the synonymy of *Indomecus* Pajni & Gandhi with *Tanymecus* Germar and on the status of *Esamus* Chevrolat (Insecta, Coleoptera, Curculionidae: Brachyderinae). *Reichenbachia Museum Tierkunde Dresden* 28 (29): 149-152.
- RAMAMURTHY, V.V., P.N. BRITTO & R.K. ANAND (1992): Further taxonomic studies on *Myloccerus* with synonymy of *Hyperstylus* (Coleoptera: Curculionidae). *Oriental Ins.* 26: 119-152.
- RAMAMURTHY, V.V., J. POORANI, C. DEVAKUMAR & PREM DUREJA (1998): Cuticular hydrocarbons and biosystematics of entimine weevil genera *Lepropus* Schoenherr and *Brachyaspistes* Fahraeus (Curculionidae: Coleoptera). *Entomon* 23 (4): 251-257.
- SUPARE, N.R., S. GHAI & V.V. RAMAMURTHY (1990): A revision of *Tanymecus* from India and adjacent countries. *Oriental Ins.* 24: 1-126.

